

WHAT IS CLAIMED IS:

1. A chemical mechanical planarization polishing apparatus comprising:  
a polishing pad;  
5 a wafer holder, the wafer holder being arranged to support a wafer to be polished using the polishing pad, wherein the polishing pad is arranged to move relative to the wafer holder such that an area of contact between the wafer holder and the polishing pad varies; and  
a force control system, the force control system including a controller and a  
10 plurality of actuators arranged to apply forces to the polishing pad, the controller being arranged to control the forces as the area of contact varies to substantially maintain a first polishing pressure on the wafer arranged to be supported by the wafer holder.
2. The chemical mechanical planarization polishing apparatus of claim 1 wherein the  
15 controller is arranged to vary the forces as the area of contact varies to substantially maintain the first polishing pressure on the wafer arranged to be supported by the wafer holder.
3. The chemical mechanical planarization apparatus of claim 1 wherein the plurality  
20 of actuators are electromechanical actuators, and controlling the forces applied by the plurality of actuators includes controlling currents provided to the actuators.
4. The chemical mechanical planarization apparatus of claim 1 wherein the  
controller is further arranged to determine the forces, the forces being determined based  
25 upon a position associated with the polishing pad, the first polishing pressure, an air pressure load on the polishing pad; and a distance between a center of the polishing pad and a center of gravity associated with the chemical mechanical planarization apparatus.
5. The chemical mechanical planarization apparatus of claim 4 wherein the area of  
30 contact varies with the position associated with the polishing pad.

6. The chemical mechanical planarization apparatus of claim 4 wherein the position associated with the polishing pad is a distance between the center of the polishing pad and a center of the wafer arranged to be supported on the wafer holder.

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7. The chemical mechanical planarization apparatus of claim 1 wherein the plurality of actuators includes a first actuator, a second actuator, and a third actuator, the second actuator and the third actuator being arranged to each apply a first force to the polishing pad while the first actuator is arranged to apply a second force to the polishing pad.

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8. The chemical mechanical planarization apparatus of claim 1 wherein the first polishing pressure is a substantially uniform polishing contact pressure.

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9. A wafer planarized using the chemical mechanical planarization apparatus of claim 1.

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10. A method for planarizing a surface of a wafer using a chemical mechanical planarization apparatus, the chemical mechanical planarization apparatus including a force system, a polishing pad, and a chuck arranged to support the wafer substantially in contact with the polishing pad, the force system including a plurality of actuators which are arranged to apply forces to the polishing pad, the method comprising:

polishing the wafer using the polishing pad, wherein polishing the wafer using the polishing pad includes rotating the wafer while the wafer is in contact with the polishing pad;

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determining a current area of contact between the polishing pad and the wafer; and

adjusting the forces applied by each of the plurality of actuators to substantially maintain a first polishing pressure on the wafer, wherein the forces are adjusted based upon the current area of contact.

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11. The method of claim 10 further including:

determining the forces to be applied by each of the plurality of actuators to substantially maintain the first polishing pressure on the wafer, wherein determining the forces includes determining a current position associated with the polishing pad,  
5 identifying the first polishing pressure, identifying an air pressure load on the polishing pad, and determining a current distance between a center of the polishing pad and a center of gravity associated with the chemical mechanical planarization apparatus.

12. The method of claim 11 wherein the current area of contact varies with the current  
10 position associated with the polishing pad.

13. The method of claim 10 wherein the plurality of actuators are a plurality of electromechanical actuators, and the forces applied by each of the plurality of actuators are arranged to substantially pull up on edge areas of the polishing pad.  
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14. The method of claim 13 wherein the forces applied by each of the plurality of actuators are varied by altering currents provided to each of the plurality of actuators.

15. The method of claim 10 wherein the plurality of actuators includes a first actuator,  
20 a second actuator, and a third actuators, the first actuator and the second actuator being arranged to be controlled substantially together to apply forces of substantially the same magnitude.

16. The method of claim 10 further including:  
25 setting parameters associated with the chemical mechanical planarization apparatus.

17. The method of claim 16 wherein the chemical mechanical planarization apparatus further includes an arm, the arm being arranged to position the polishing pad, and  
30 wherein the parameters include at least one of the first polishing pressure, a polishing

time, a chuck rotating speed, a polishing pad rotating speed, and an arm moving trajectory.

18. A force control system suitable for maintaining approximately a first polishing pressure on a wafer being polished using a polishing pad of a chemical mechanical planarization apparatus, the force control system comprising:

a controller, the controller being arranged to determine a first suction force and a second suction force that are suitable for enabling a first polishing pressure to be applied to the wafer while the wafer is being polished;

10 a first actuator, the first actuator being arranged to apply the first suction force at a first area approximately near an edge of the polishing pad to substantially pull up on the edge of the polishing pad; and

a second actuator, the second actuator being arranged to apply the second suction force at a second area approximately near the edge of the polishing pad to substantially pull up on the edge of the polishing pad.

19. The force control system of claim 18 wherein the controller is arranged to determine the first suction force and the second suction force based on a contact area between the wafer being polished and the polishing pad.

20. The force control system of claim 19 wherein the controller is further arranged to determine the first suction force and the second suction force based on the first polishing pressure, a location of a center of gravity of the chemical mechanical planarization apparatus, an air pressure load applied on the polishing pad, and at least one location associated with the polishing pad.

21. The force control system of claim 18 further including a third actuator, the third actuator being arranged to apply the second suction force at a third area approximately near the edge of the polishing pad to substantially pull up on the edge of the polishing pad.